

SOME OBSERVATIONS ON THE LIFE CYCLE OF
VELACUMANTUS AUSTRALIS (QUOY AND GAIMARD)
(GASTROPODA: POTAMIDIDAE)

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Pl. 9, Text figs. 1-5

SUMMARY

The Australian Mud Whelk, *Velacumantus australis*, is common in certain places along the eastern and southern coasts of Australia. Two populations from Narrabeen Lagoon, near Sydney, were studied over the period of one year. Breeding takes place during the summer. Most snails probably breed for the first time at the end of their second year, many die during the next year, but some probably live into their fourth year. Details of the growth of juveniles, and changes in population structure with time, are given.

INTRODUCTION

Velacumantus australis (Quoy and Gaimard) (synonym *Pyrazus australis*), the Australian Mud-Whelk, is common in certain kinds of places along the eastern and southern coast of Australia. It occurs as far north as southern Queensland, and ranges as far as Tasmania and South Australia. Large numbers are often found on sandy mud-flats in the intertidal zone of sheltered bays, estuaries, and in coastal lakes, where it is usually the dominant mollusc. In some places there may be as many as 200 of these snails per square foot. *V. australis* lives in shallow water up to about two feet deep, but deeper waters have not been examined.

V. australis harbours several larval trematodes the adult stages of which live in birds. (Bearup 1955, 1956, 1960, 1961). One of these parasites is the larval stage of the schistosome *Austrobilharzia terrigalensis* Johnston, which normally completes its life-cycle in aquatic birds. The larvae emerge in large numbers from infected snails during the warm summer months and may penetrate the skin of man, producing "Swimmer's Itch" or "Schistosome dermatitis". This condition is not uncommon along the coast of New South Wales in places where the host snail occurs, and is sometimes known locally as "Pelican Itch".

Knowledge of this condition has been summarised by Cort (1950). It has been recorded from many parts of the world, and is caused by a number of different schistosome species most of which live in freshwater snails. Within the last ten years there have been a number of records from marine situations (Chu, 1958). Another dermatitis-producing schistosome occurs in the siphon shells, *Siphonaria* and *Talisiphon*, which live on marine rock platforms around Sydney (Ewers, 1961).

While studying the incidence of the larval trematodes in *V. australis* some observations were made on the life cycle of the snail host. These form the substance of this paper.

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MATERIAL AND METHODS

1. *The areas studied:* *V. australis* occurs in parts of Narrabeen Lagoon, 16 miles north of Sydney. Two areas of this lagoon were chosen for study and samples of the *V. australis* populations were collected at approximately monthly intervals. Each snail was measured and examined for larval trematodes. A few samples of *V. australis* from other places were also examined.

Narrabeen Lagoon is a shallow estuarine body of water about 2 miles long with several small freshwater creeks running into it. It is usually separated from the sea by a sand-bar, but salt water enters occasionally at high tide or when a channel is deliberately cut through the sand-bar. The salinity of the water varies from time to time. Mostly it is close to that of sea-water, but sometimes is less than half this value. (Bearup, 1955, 1956).

Both the areas studied were near the outlet of the lake between the Pittwater Bridge and the Ocean Street Bridge. A channel runs through this region and it is bounded by sandy mud-flats, with some backwater pools. At times water drains from the lake and these mud-flats are exposed, and the backwater pools become more or less separated from the main channel. Weed beds of *Zostera* cover much of the area.

The two areas studied are designated in the text "The Loftus Street Area" and "The Camping Reserve Area". The Loftus Street Area consists of a shallow backwater of the lake about 100 yards from the shore. It is about 35 yards long and 15 yards wide, almost completely bounded by sand-bars. To the west there is a large sand-flat about 100 yards wide which separates the area from the main channel. The area supports a thick growth of *Zostera*, and during part of the summer, filamentous green algae. The water is usually 9-18 inches deep, but may be up to two feet deep when the water level is very high. At such times the sand-bars and sand-flats surrounding the area are completely under water and the backwater is continuous with the rest of the lake. *V. australis* is the dominant mollusc. *Pyrazus ebeninus*, a closely related species is occasionally found but is extremely rare in comparison with *V. australis*. The juveniles of these two species are difficult to separate, especially when they are very small. Plate 9 shows a series of juveniles and adults of these two species.

The Camping Reserve Area is about half a mile from the Loftus Street Area. It is nearer the sea and close to the Ocean Street Bridge. In this area the shore slopes gently into the main channel. About 30 yards of shore were sampled, all samples being collected within five or six yards of the shore in water up to two feet deep. The area supports a thinner growth of *Zostera* than the Loftus Street Area. *V. australis* is again the dominant mollusc and is much more abundant than at Loftus Street.

One large sample was taken from the beach at Wharf Street, Kogarah Bay. This area is a mud-flat with sandstone outcrops and stones.

2. *Methods of Collecting Samples:* It is easiest to collect *V. australis* at low tide, when they can be seen. However, there is seldom any tidal movement in Narrabeen Lake, and the snails had to be collected by feeling for them while crawling about on hands and knees. A sock hung about the neck is a convenient collecting receptacle, as it leaves both hands free. Very few snails smaller than 10 mm. long were collected by this method. Because of this there are no adequate samples of very young juveniles.

The population at Loftus Street was never very dense and the snails tended to have a patchy distribution. Several snails would often be found close together, and often areas of several square yards were searched without finding a snail. Much of the area was searched each

time a sample was collected, and because the snails could not be seen, collections would seem to be representative of the whole population.

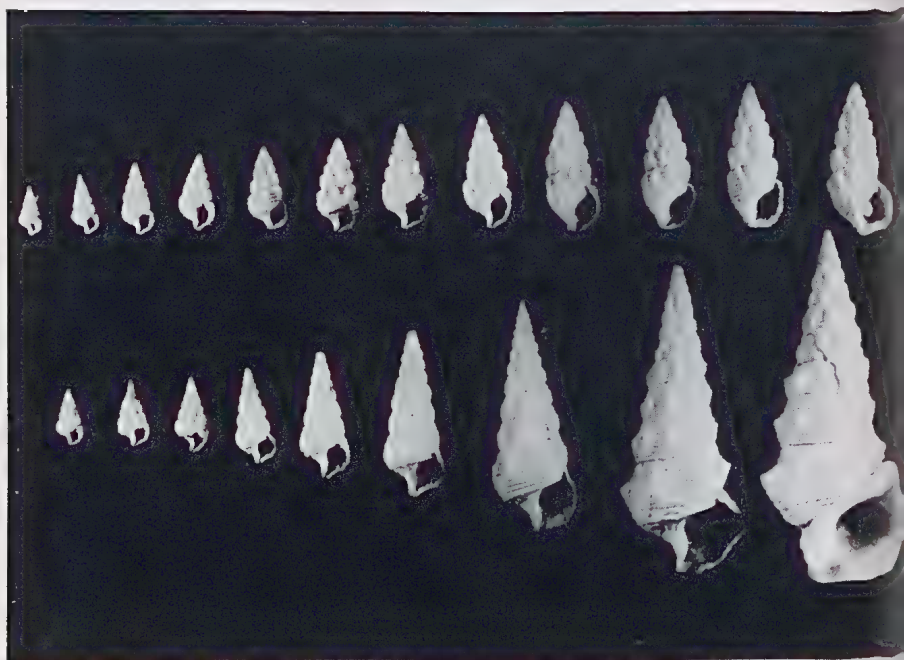
V. australis were very much more abundant at the Camping Reserve Area, and an attempt was always made to collect snails randomly over the whole area.

Originally it was decided to collect 100 snails from each population each month. With the onset of winter adult snails were hard to find, especially in The Loftus Street Area, and some samples were, unfortunately, too small. This was due to several circumstances. Firstly, many adult snails die with the onset of winter, due to senility and probably also the adverse effects of the trematode infections that they harbour. Secondly, the Loftus Street population was depleted by the removal of several large samples taken to provide experimental material. Thirdly, it was often impossible to stay in the water for more than an hour during the winter because of the temperature. On most occasions all snails that were collected were included in the samples irrespective of size.

The snails of each sample were divided into adults and juveniles on the basis of the degree of thickening of the shell. Growth in *V. australis* is apparent as an increase in length until adult length is reached. The lip of the opening of the shell then begins to thicken. The snails do not increase in length very much, if at all, after this thickening starts. All snails which had an unthickened lip were classified as juveniles, all others as adults.

PLATE 9

A growth series of *Velacumantus australis* (Q. & G.) upper row, and *Pyrazus ebeninus* (Brug.) lower row, illustrating the similarity of the young shells and the differences in the adult shells. All specimens from Kogarah Bay, N.S.W. Scale in millimetres.



When the juvenile snails are small it is easy to differentiate them from adults; as they approach maturity it is more difficult. There was probably some variation from time to time, in the classification of adults and juveniles, but I doubt if it has been important. Late in the study the juveniles were differentiated from the adults according to whether the lip of the shell was fragile enough to be broken between the fingers. This method for the differentiation of adults and juveniles seems to be more consistent than visual assessment.

The maximum length of each snail was measured to the nearest millimetre, with a pair of callipers, and after measurement, the snails were examined for larval trematodes.

V. australis can be easily kept in the laboratory in aerated aquaria containing an inch or two of mud from their habitat.

RESULTS AND DISCUSSION

Data on the measurements of juvenile and adult snails are presented in the length-frequency histograms of Figures 1 (Loftus Street) and 2 (Camping Reserve). It would appear that the juveniles belong to one generation and that breeding is confined to a relatively short period of a month or two.

The histograms of Fig. 1 show that the generation of juvenile snails was about 16 mm. long in November, 1959. By January, 1960, the longest of these were as long as the smallest adults in the population. From then on the lengths of juveniles and adults overlap. The length of adult snails ranged from 27 to 47 mm., and the juveniles ranged up to 41 mm. Comparisons of the histograms of juveniles of one month with the histograms of adults for the successive month suggest that by June or July the first juveniles were becoming adults. Many had still not become adult by November, 1960. The histograms for The Camping Reserve Area also suggest that the juveniles of that population were becoming adults by June, 1960.

Figure 3 shows that the proportion of juveniles in both the populations changed in the same way. This is expected in that the two populations were living in very similar neighbouring environments, and could be expected to breed at about the same time and grow at about the same rate. The proportion of juveniles in the population at the Loftus Street Area was higher than in the other population. This was probably due to the large numbers of adult snails that had been removed from The Loftus Street Area for experimental purposes.

The proportion of juvenile snails in the populations increased until July and then decreased. It would appear that up to July many adult snails were dying. From July until September the proportions of juveniles decreased. This must have been because they were changing into adults. Many adults were probably still dying but their numbers were being replaced by juveniles that were reaching maturity. Between September and November the proportion of adults decreased. It would appear that during this period many of the remaining old adults died. At the end of July the incidence of trematode infections in adult snails, reached a peak and these probably caused the death of many adult snails in the next few months. A small number of living specimens are found which appear to be older than the rest of the adults. I think these may well be snails that are in their fourth year.

Dr. J. Clegg of the Australian National University, Canberra (personal communication), has suggested that migration occurs in a population of *V. australis* at Moruya Heads, southern New South Wales. If the snails at Narrabeen do migrate, some of the observations recorded in this paper would have to be interpreted differently. However, it is unlikely that the population at Loftus Street undergoes any migration,

because the area is, for most of the time, virtually landlocked. At no time did I observe any change in the populations at Narrabeen that suggested that migration was occurring.

From December, 1959, until November, 1960, some 80 shells of adults and large juveniles were found in which the spire of the shell had been broken, presumably by a predator. The incidence of these broken shells was highest from May until July. The shells of *V. australis* are hard and thick and it would take a predator with very powerful mouth-parts to break them. The predator may be a crab or fish, or possibly a bird.

Figure 4 shows the average length and standard deviation of juvenile snails taken from Loftus Street. The average length of the first sample

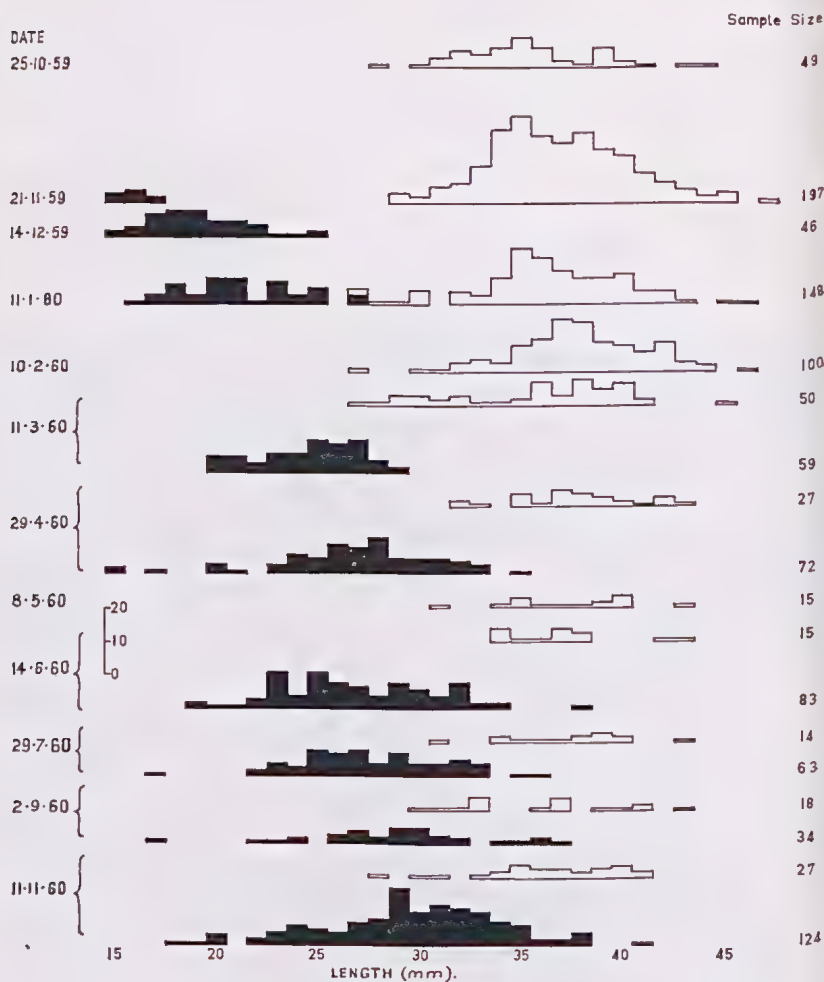


FIGURE 1. Length/frequency histograms of samples of *V. australis* collected from Loftus Street, Narrabeen.
[Juveniles solid, Adults line figures]

taken in November, 1959, was nearly 16 mm. There were only 8 snails in this sample and they were probably the largest of the juvenile population at that time, because the very smallest snails would tend to be missed from the samples. Figure 4 shows that the juveniles took about 12 months to grow from an average length of about 15 mm, to 30 mm. While this graph can be expected to follow the usual sigmoid growth curve, its precise mathematical form cannot be determined because no data are available for very young stages. Because of this it is impossible to extrapolate with any accuracy. However, extrapolation would suggest that this generation of snails hatched late in 1958 or early 1959. MacIntyre (1961) states that *V. australis* laid eggs in aquaria during February, so it is likely that breeding occurs sometime during the warm summer months.

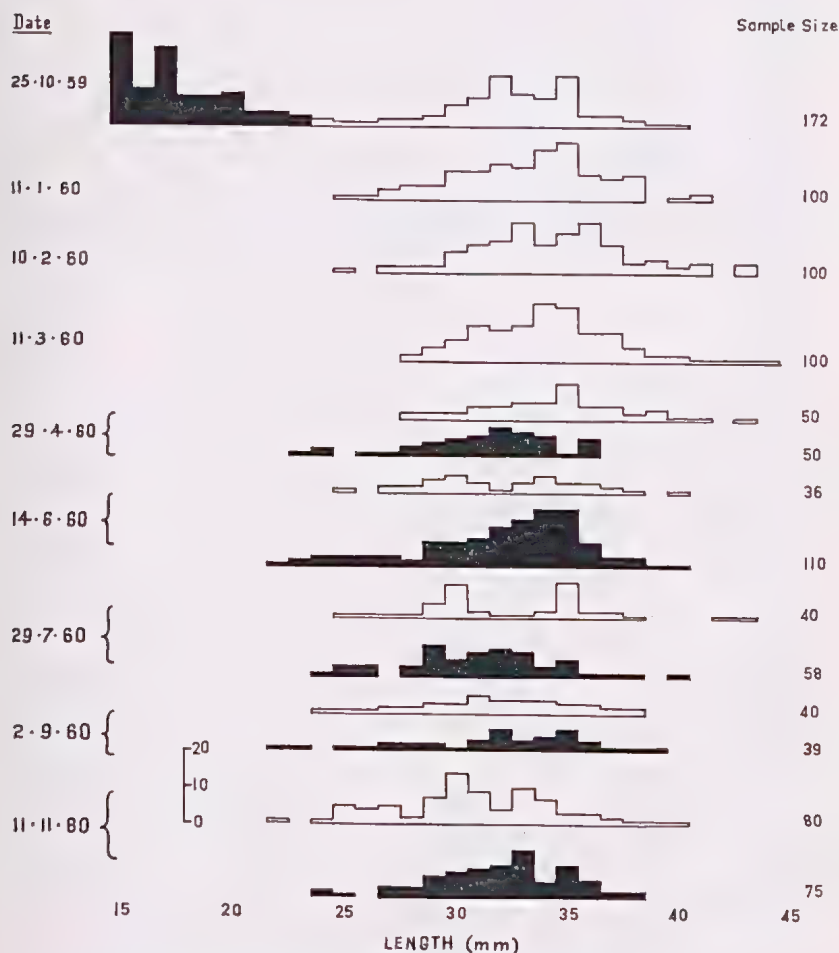


FIGURE 2. Length/frequency histograms of samples of *V. australis* collected from the Camping Reserve Area, Narrabeen. [Juveniles solid, Adults line figures]

Fig. 4 also shows that the rate of increase in length slowed down between May and November. During this period many of the juveniles were changing into adults. There would be a tendency for the longest to become adult first and thus lost to the juvenile population. This would cause a decrease in the growth rate of the juvenile population. When juveniles start to change into adults the anabolic processes, which have previously been concerned with growth in length, switch over to processes concerned with the thickening of the shell lip. This is illustrated by Figure 5 which shows the length/weight relationship of adult and juvenile snails collected from Kogarah Bay. A total of 325 snails (235 juveniles and 90 adults) were measured and weighed after being dried in an oven at 120°C. for about 8 hours. These were selected from about 1000 snails so that, as far as possible, a number of each length were included. Figure 5 shows that the average weight of juveniles is always less than that of adults of the same length. However, there is a good deal of overlapping of the weights of juveniles and adults of the same length as is shown by the data in Table 1. The data in this table are the same as those used in Figure 5.

The largest juveniles from Kogarah were only 2 mm. shorter than the largest adults in the same population. Over the whole period of study, 87% of the adults from The Loftus Street Area and 98% of them from The Camping Reserve Area were within the size range of the juvenile population. The largest adults taken from these areas were 47 mm. long. At times when adult snails were comparatively scarce, it is possible that due to personal inconsistency, some of the longer snails that had started to thicken were classified as adults. At other times some of these same snails would probably have been classified as juveniles.

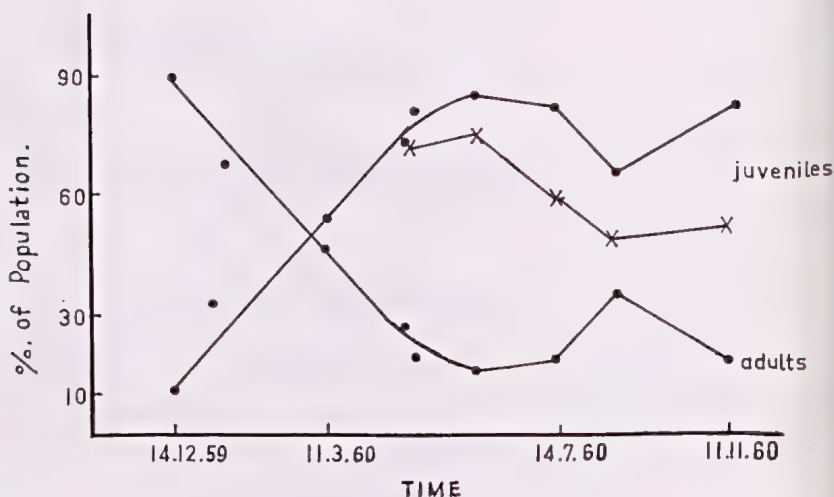


FIGURE 3. Changes in the proportion of juvenile and adult snails, with time, in the populations at Loftus Street (●) and the Camping Reserve (x), Narrabeen.

It would appear that young *V. australis* snails increase in length and weight in a regular fashion up to the time they thicken the mouth of their shells. This may occur any time after they are longer than 27 mm. When this thickening begins the shells must increase in weight quite markedly without increasing in length more than a millimetre. Once the process of thickening is completed a snail cannot increase in length, because growth in length occurs as new shell material is laid down in a spiral at the aperture of the shell. Once the aperture becomes completely thickened further growth in length is impossible.

It is apparent that size is not a good indicator of maturity. There is a minimum length below which no snails are found with thickened shells, but many snails do not start to thicken their shells until they are

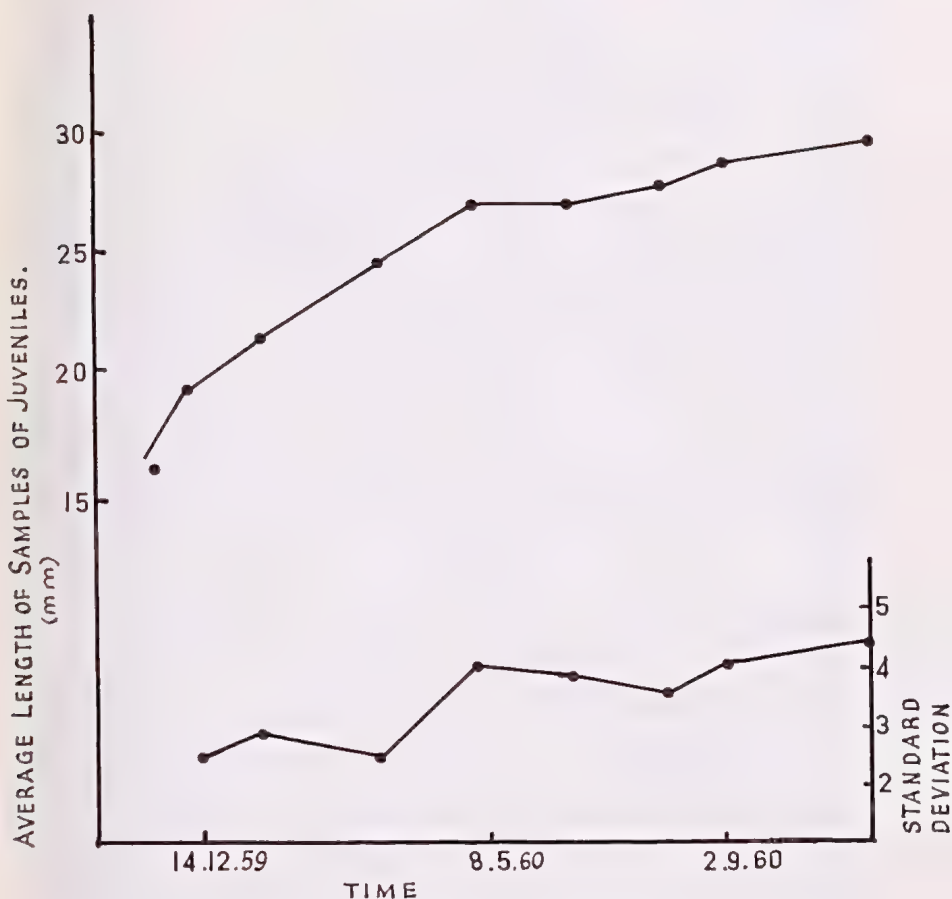


FIGURE 4. The average length and standard deviation of samples of juvenile snails from Loftus Street, Narrabeen, plotted against time.

very much longer than this. It is possible that the onset of the thickening process (of "puberty") is influenced by certain environmental factors, such as some component of weather, so that the new population becomes sexually mature when seasonal conditions are most favourable.

The observations on the life cycle of *V. australis* presented in this paper are very incomplete. This has been inevitable because the investigation was primarily concerned with the larval trematodes in this snail, and not with its life cycle as such. However, in view of our limited knowledge of the life cycles of marine molluscs, it was considered that sufficient data were available to warrant publication.

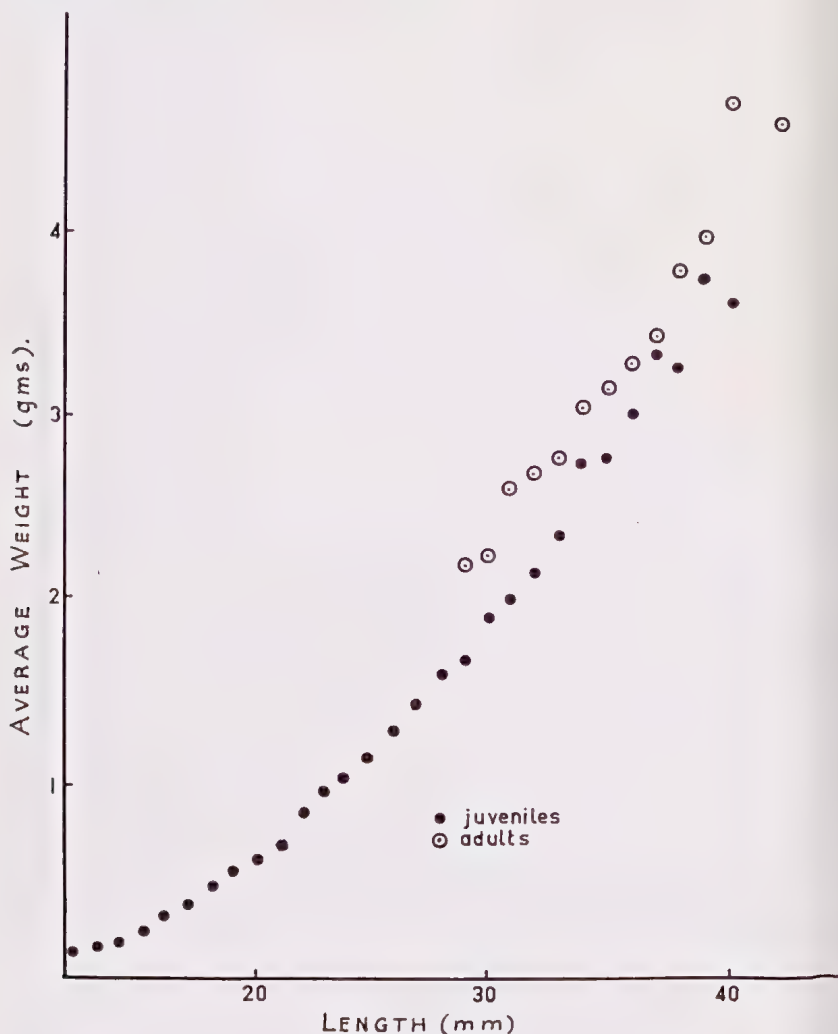


FIGURE 5. The Length/Weight Relationship of *V. australis* snails from Kogarah Bay.

TABLE I

length (mm.)	JUVENILES		Number in sample	ADULTS		Number in Sample
	weights (gms.)			weights (gms.)		
	Average	range		Average	range	
29	1.65	1.43 - 1.82	12	2.17		1
30	1.87	1.57 - 2.09	9	2.22		1
31	1.98	1.70 - 2.15	10	2.57	2.17 - 2.76	5
32	2.11	1.65 - 2.34	10	2.66	2.20 - 3.13	10
33	2.33	2.13 - 2.77	6	2.77	2.37 - 3.19	8
34	2.71	2.51 - 3.04	8	3.03	2.55 - 3.73	10
35	2.76	2.04 - 3.22	9	3.13	2.79 - 3.43	14
36	2.95	2.60 - 3.26	9	3.29	2.64 - 3.85	15
37	3.31	3.13 - 3.58	7	3.42	2.68 - 3.86	10
38	3.23	2.97 - 3.40	5	3.77	3.23 - 4.05	6
39	3.72		1	3.96	3.65 - 4.31	6
40	3.60	3.59 - 3.60	2	4.70	4.66 - 4.74	2
41			0			0
42			0	4.57	4.06 - 5.08	2

The average weights and the range of weights of juveniles and adults of *V. australis* of various lengths.

The life cycle of *V. australis* may be summarised as follows. Breeding takes place during the summer, probably in a fairly restricted period somewhere between December and March or April. Within about 15-18 months the first of the juvenile population have thickened their shells and become adults. By the end of two years all the juveniles have probably become adults, and they breed towards the end of the second year. After becoming adults the snails do not increase in length. Many adults probably die within twelve months after breeding, that is before they are three years old. Some probably live into their fourth year. The snails do not become infected with larval trematodes until they are approaching maturity, so that the number of snails susceptible to trematode infection increases, as each generation becomes adult.

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